

**Geologic Mapping and Drainage Basin Analysis in Margaritifer Sinus, Mars;** John A. Grant, SUNY College at Buffalo, Earth Sciences, Buffalo, N.Y., 14222, grantja@snybufaa.cs.snybuf.edu.

**Introduction:** The Margaritifer Sinus region within the cratered highlands of Mars is located near the eastern end of Valles Marineris and approximately 1000 km northeast of Argyre Planitia. The region serves as a focus for the occurrence of a wide variety of valley and channel forms including: one of the highest densities of well-integrated valley networks (1-6), meso-scale outflow channels (7-8), and outflow channels (5, 9-11). In an attempt to refine understanding of the evolution of valley and channel networks in and near southeastern Margaritifer Sinus (MC19SE), drainage basin mapping is being undertaken as part of a NASA funded effort to systematically map Mars MTM quads -10022, -15022, -20012, -25012. Efforts involve detailed geologic mapping and evaluation of drainage morphometry in topographically defined basins. The goal is to better define the timing (*e.g.*, 12, 13), processes (*i.e.*, runoff, sapping, mass wasting, or combination thereof, *e.g.*, 3-5, 11, 13-17), and geomorphic thresholds contributing to formation of these enigmatic drainage features.

**Geologic Mapping:** Two major valley systems, Samara and Parana/Loire Valles, drain from southeast-to-northwest across MC19SE and discharge into the area of Margaritifer Chaos. Stereo mapping using Viking Orbiter images reveals that these networks and associated basins cover more than 540,000 km<sup>2</sup>, preserve sub-basins and partially filled depositional sinks, and appear relatively pristine (Fig. 1; 6, 18-19). Preliminary evaluation of Samara and Parana/Loire Valles confirms low densities (~0.03 km/km<sup>2</sup> for Samara Valles, ~0.03 km/km<sup>2</sup> for Loire Valles, and ~0.07 km/km<sup>2</sup> for Parana Valles) and identifies a number of internal drainage basins between the two systems (Fig. 1). A number of well-defined sub-basins are also distinguished that possess similar drainage densities (0.03-0.07 km/km<sup>2</sup> for Samara sub-basins and 0.02-0.1 km/km<sup>2</sup> for Parana/Loire sub-basins), are remarkably well-integrated, and typically drained by fourth order trunk valleys (Strahler classification, 20) whose associated networks extend across basins to near the divides (Fig. 1). Overall similarities between valley densities, degree of integration, and stream order in the Samara and Parana/Loire basins suggest the regional rate/intensity of formational activity was comparable, regardless of the process(es) responsible.

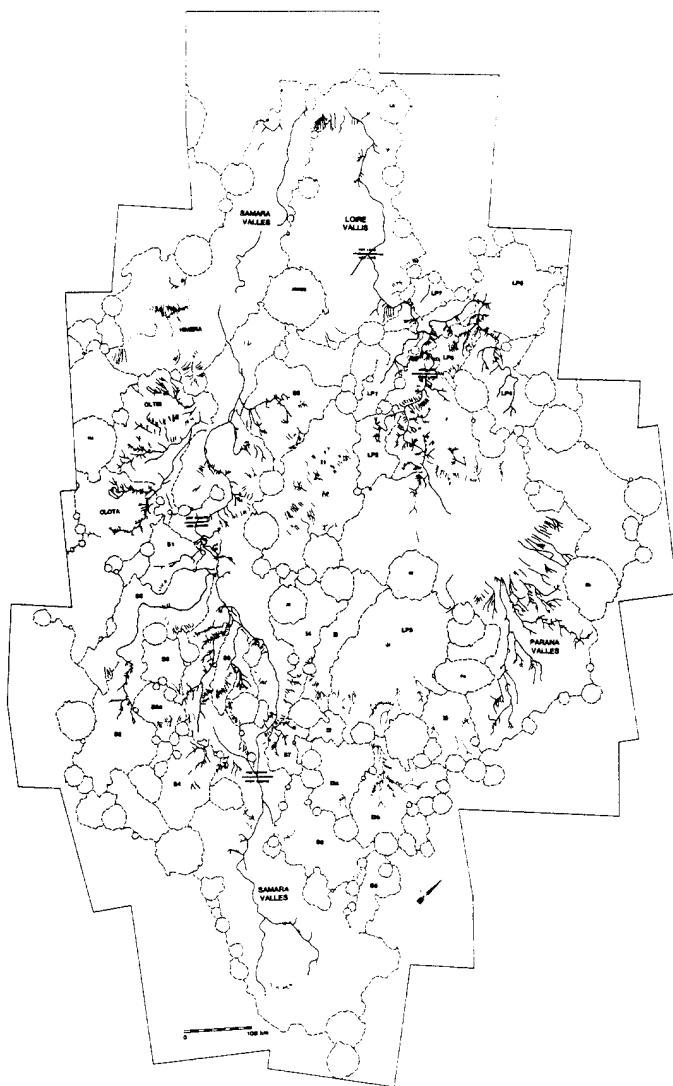
Drainage densities were derived using preserved valley length divided by topographic basin area and are lower than those typically associated with terrestrial systems formed by runoff. Further evaluation as to the significance of these differences is required, however, because: A) adjustments have not been made to account for differences in the resolution at which most terrestrial drainage densities are derived, and B) there has been no attempt to modify densities in areas where post-valley resurfacing has obviously destroyed some drainage segments. Hence, the measured densities may not be as comparable to those associated with groundwater sapping as has been inferred.

In addition to valley and channel features, the terrain in and near MC19SE preserves a long history of activity by diverse geologic processes. The oldest recognizable features are three degraded multi-ringed impact basins, Holden, Ladon, and Noachis, whose rings extend through much of the region including the basins of Samara and Parana/Loire Valles (10, 21). The structural elements of these basins strongly influenced the location and density of the later forming valleys and channels. Crater statistics suggest three events resurfaced varying portions of the region following formation of these basins, but before evolution of the preserved valleys. The first two occurred during the early-Noachian with the second drawing to a close at an N5 age (number of craters larger than or equal to 5 km in diameter per 1,000,000 km<sup>2</sup>) of approximately 1400. The third resurfacing event began during the mid-Noachian (N5 of 500) and drew to a close in late-Noachian (N5 of 300). Preserved valleys and associated deposits in MC19SE respectively incise or embay materials emplaced during the third resurfacing event. Once begun (N5 age 300), valley formation persisted through the late-Noachian into the early-Hesperian (N5 age 150). The timing of valley formation in the area is supported by results of other studies (22). A fourth, more localized resurfacing event continued through the early and mid-Hesperian (N5 ages between 200 and 70) and emplaced materials that embay valleys.

**Discussion:** The study presently underway involves a combination of geologic mapping of surfaces near and below Parana Valles and in the area of the confluence plain between Samara and Parana/Loire Valles. Together with compilation of crater statistics, this approach provides context for refining the nature and timing of geologic events in the region. Possible relationships between the valleys in MC19SE, downstream sinks and channels, nearby channels systems (*e.g.*, the Uzboi/Holden/Ladon/Margaritifer system), and other geologic units are also being investigated. A comprehensive assessment of drainage morphometry using topographically defined basins (Fig. 1) is underway and should permit more accurate comparisons with a broader range of terrestrial drainage

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characteristics that may relate to the origin of Martian valleys. This effort includes: A) reconstruction of drainage courses modified by resurfacing (where possible); B) comparison between Martian and terrestrial systems at broadly similar resolutions; and C) comparison between the volume occupied by valleys and their downstream depositional sinks. Previous studies targeting drainage basin morphometry (e.g., 4, 5, 11, 12, 17, 23-26) yielded a mix of information regarding formational processes that may relate to examination of only portions of drainage systems, use of watershed areas that were not defined topographically, and/or comparisons to data from terrestrial systems compiled at higher resolution. The approach employed in the current study should provide a test of previous models for valley evolution, identify possible relationships between valleys and nearby channels, and predict locations where data collected by Mars Global Surveyor can yield maximum information related to the valley systems.



**Fig. 1.** Samara and Parana/Loire Drainage Basins.

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